A FLUORESCENT BALLAST WITH EMERGENCY LIGHTING CAPABILITY

Priority Claimed on SN.60-281,841 filed 4-6-01 (ABANDONED)

Continuation in part of patent application SN. 10/104,076 filed 3-21-02 (PENDING)

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of power inverters used for electronic lighting ballasts and the use of stand-by battery power in order that the same ballast may be used to provide emergency lighting at a lower level to conserve battery life in the event of power failure.

2. Brief Description of the Prior Art

There are many varied public domain circuits involving the generation of high frequency inputs for driving fluorescent lamps, compact fluorescent lamps, high intensity discharge and other forms of gas discharged lighting. There are ballasts that operate on direct current that are driven from a battery to supply emergency lighting. Where emergency lighting is needed the standard fixture will contain a regular line current driven ballast as well as a direct current ballast and a battery. In some cases a single battery may be used to supply direct current to several fixtures with emergency lighting capability. Unless, with added expense, transfer relays are employed a separate lamp must be installed in the fixture. Emergency lighting provides the minimum light required to evacuate a building. This is necessary to allow the battery to last as long as possible and not be overly large and expensive. A charging method for the battery must also be provided. In spite of the direct current ballast being smaller because of the lower power required there is still considerable additional expense involved is providing emergency lighting.

SUMMARY OF THE INVENTION

Accordingly, the above problems and difficulties are obviated by the present invention which incorporates a ballast with circuitry to allow the level of the lighting

device to be adjusted, a separate direct current input and a sensing means within the ballast to lower the light level and thus the amount of power required from the direct current input when the normal line power fails. A method of recharging the battery by supply current to flow out of the direct current input when the ballast is operating from line power is also provided.

OBJECTS OF THE INVENTION

Therefore, it is among the primary objects of this invention to supply a simple and easy method to provide emergency utilizing only a single ballast for a gas discharge lighting device.

It is another object of this invention to reduce the amount of energy used to provide the emergency lighting over that required for normal lighting and thus increase battery life.

Yet another object of the invention is to provide a ballast that will operate from either alternating or direct current power.

Yet still another object of the invention is to provide a method of direct connection to a battery including maintaining a charge on the battery while in normal lighting mode.

A further object of the invention is make this ballast part of an overall lighting system.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to it's organization and manner of operation, together with further objects and advantages thereof, may best be understood with reference to the following description, taken in connection with the accompanying drawings in which:

FIGURE 1 shows a prior art half bridge configuration of an inverter with switching alternately applied again between points A and B. Because switching device A is not connected to the common bus, only certain types of switches may be used practically in this application. For example, a vacuum tube would be very difficult but

not impossible to apply here. When switching transistor 88 is on current flows from the plus DC supply through DC blocking capacitor 9 to the series resonant circuit consisting of inductor 9 and capacitor 10. The load is connected across capacitor 10;

FIGURE 2 is a block diagram of a preferred embodiment of the subject invention driving a gas discharge lighting device;

FIGURE 3 depicts a change in the preferred embodiment of FIGURE 2 to drive a flat panel lighting device; and

FIGURE 4 is a schematic representation illustrating a microprocessor chip as part of the control module of FIGURE 2.

OPERATIONAL DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to Figure 2, electrical power enters from the AC power line on lines 1 and 2 to the AC to DC converter module 3 and leaves on lines 4 and 5 as plus and minus DC power. Line 5 is considered the common of the ballast circuit. The AC to DC conversion module 3 can be any form of public domain conversion system. In this instance 4 diode bridge is depicted. The DC voltage and current is further conditioned and regulated to correct the power factor and harmonic distortion with respect to the power line by regulator and/or power conditioner 86 which could be any form of public domain regulator such as the method depicted in my patent No. 4,277,728, now expired. And/or is used as in some applications only power conditioning is needed and in other cases only regulation in needed. A single circuit does either or both but the one that does both is more expensive to manufacture.

Block 6 is the half bridge converter as shown in Figure 1. Line 17 connects point A of Figure 1 to the control and drive module 24. Line 18 connects point B of Figure 1 to the control and drive module. The output of the half bridge 6 is on line 7 and connects, via DC blocking capacitor 9, to inductor 8. It also connects to control and drive module 24 via line 19. DC blocking capacitor 9 is large enough that its value does not enter into the resonant calculation but acts simply to pass the AC with little or no impedance while

totally blocking any DC component from flowing into the load. Inductor 8 and capacitor 10 make up a series resonant circuit that converts the square wave output of the half bridge to a sine wave. This is applied to the output load in this case a gas discharge lighting device 15 by line 16 and through current sensing resistor 32 to line 11. Transformer 12 connected between line 16 and through current sensing resistor 72 to line 11, across the load, provides power for the lamp's heaters 91 and 92 from secondary windings 13 and 14 respectively.

Control module 24, which will be further discussed under the description of Figure 4, receives the current feedback from current sense resistor 32, which also may be any other form of current sensing device, via line 22. Output voltage across the load is fed back on line 21. This line also serves to feed back the phase of the sign wave that is presented across the load and may be used by the control module to maintain a resonant frequency if required. Heater current is fed back via line 73 as a voltage drop across resistor 72 which is in series with the primary of heater transformer 12. When power line carrier signal is used to send control information to the control and drive module, the signal is presented to the module through lines 25 and 26. The signal on lines 25 and 26 also allows the control module to determine if AC line power is being applied to the ballast for activation of the emergency lighting features of the ballast. The Photocell input 27 which is either all of the amount of light delivered by the load, or a series of operational input control pulses or the amount of light on the surface illuminated by the lighting device is fed through line 27 or both. Manual control is supplied through line 28 and remote control when used comes in on line 30.

Logic power to the control module is provided from the logic power module 23 which is supplied from either the DC bus 4 via line 93 for start up or winding 95 on inductor 8 via line 96. A supply of isolated power for the operation of various control devices by tapping power from inductor 8 via secondary 97 connected by lines 98 and 99 to bridge rectifier 100. The output of bridge rectifier 100 is fed via line 101 to regulator 102 while line 104, connected to the (-) side of the bridge rectified becomes the common for this isolated supply which is output at 103.

Direct current enters at the input 85 and flows through diode 83 to the DC bus 4. Typically this DC voltage will be much less than the peak AC line voltage so regulator 86 will be of the boost type to present a constant voltage on line 87. Under DC operation this will not be a problem for the regulator circuit as the control module, sensing the absence of the AC line input, will reduce the power output considerably and thus the power drawn by the half bridge inverter 6. During this time the charging circuit is disabled as the voltage at its input and output is essentially the same. When the AC line voltage is present the DC bus voltage is used as the source for the charging circuit 84 that returns current to the direct current input 85.

Referring to Figure 3 the connection for the electro-luminescent or flat panel lighting device 31 is shown. The two points X and X are connected in Figure 3 where the X and X's are to replace the circuitry to the right of the X's in Figure 2. Inductor 8 is connected in the same manner, but capacitor 10 of Figure 2 s replaced by the electro-luminescent panel itself, 31. The panel is, in fact, a large capacitor, therefore, it serves not only as the load, but as the resonant capacitive element. The DC blocking capacitor of Figure 9 is not needed since the load itself is a capacitor. The amplitude and phase angle of the voltage across the panel is fed back to the control module the same as before via line 21. The current in the panel is measured by the voltage drop across resistor 32 is the same manner as in Figure 2 via line

Referring now to Figure 4 logic power for the microprocessor is fed in on line 44 from the logic power module. It is further filtered by capacitor 45 and supplied to the microprocessor at the Vdd input 14 on line 46. The operating frequency of the processor chip is set by the selection of crystal or resonator 50 which is loaded by capacitors 42 and 51 connected to the processor at the oscillator inputs 15 and 16 by lines 41 and 49. The frequency is varied according to the application. For example, when driving a flat panel display, the frequency is between 800 and 1,000 hertz and the crystal would most likely be a resonator. When driving a high-intensity discharge lamp, the frequency may be as high as 100 kilohertz or more. Typical fluorescent lamp applications operate in a frequency between 20 and 70 kilohertz. The microprocessor output is at pins 6 and 8. Pin 6 is connected directly by line 18 to the drive point B to turn on the bottom transistor in the half bridge. Output Pin 8 is connected by line 53 to high side driver 52 to drive the

top transistor at point A via line 17. Since this transistor is not referenced to the common bus, a high side driver must be employed. Power for the high side driver used to drive the transistor is created by charging capacitor 56 through diode 55 when the output of the inverter bridge is low and the bottom transistor is on.

The voltage across the output load is fed back by line 21 and divided by voltage divider resistors 58 and 59 to a voltage that is acceptable to the processor. It is then fed by line 114 to input 7 to allow the microprocessor software to determine the phase angel of the output voltage. By adjusting the frequency to maintain a 90 degree phase shift across the resonant inductor 8 the processor can be sure that the output is always at resonance. The voltage at the junction of resistors 58 and 59 is also rectified by diode 60 and filtered by capacitor 62 and load resistor 61 to input 3 via line 63 to allow the microprocessor to determine the output voltage magnitude. This is very useful when driving the flat panel display of Figure 3.

The load current is sensed by sensor 32 of Figure 2 and is fed in via line 22 to capacitor 106 which is part of a voltage doubler consisting of capacitor 106 diode 108 and diode 74. A doubler is used so current sense resistor 32 may be reduced in size by a factor of 2 thus reducing any heat loss the resistor. The doubled voltage is filtered by capacitor 66 and resistor 65 and presented to analog input at Pin 1 via line 67. The voltage representing the heater current is fed on line 73 to doubler consisting of capacitor 105, diode 107 and diode 74 and filtered by capacitor 76 and load resistor and fed by line 77 to the microprocessor. Local control of the output power may be adjusted by potentiometer 70 of Figure 2, the wiper of which is connected at input 17 via line 28. Resistor 71 in series with potentiometer 70 sets the minimum output level. An analog input voltage from the photocell is presented by line 27 to input at Pin 18.

Remote control is normally a pulse width modulation control system, therefore, it is digital and is presented by line 30 to digital input at Pin 12. If a power line carrier signal is sent, it is sensed on lines 25 and 26 at inputs 10 and 11 which look for changes on the power line signal at the zero crossing point. Two inputs are used to look for each half cycle of the power line. Resistors 110 and 111 act to limit the current flowing into and out of the microprocessor. The absence of signal on these two lines also tells the